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International Journal of Current Research
Vol. 8, Issue, 09, pp.39290-39294, September, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ORGANIC SEEDLING PRODUCTION IN PADDY

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ARTICLE INFO

Article History:
Received 10th June, 2016
Received in revised form
23rd July, 2016
Accepted 27th August, 2016
Published online 30th September, 2016

Key words:

Inorganics, Organics,
Oryza Sativa, Paddy,
Root Atpase Activity,
Seedling Growth.

ABSTRACT

The field experiment was conducted in two seasons' *kharif* 2013 and *kharif* 2014 in the farmers' organic field at Neer Manvi, Manvi Taluk, Raichur District, Karnataka, India. With a view to know the influence of organic nutrients on growth, development and root ATPase activity of paddy seedlings. Experiment was laid down in RBD design with three replications and 13 treatments. Among the treatments, inorganic treatment (RDF) recorded significantly highest mean shoot length (15.35 and 20.29 cm), chlorophyll content (25.09 and 33.20 SPAD value), dry matter production (0.489 and 0.617 g seedlings^{-10}) and number of thrips (5.20 and 4.25) at 20 and 25 Days after sowing (DAS), respectively. Whereas, maximum mean root length (10.10 and 17.03 cm), root volume (1.007 and 1.123 cc seedling $^{-1}$) and root ATPase activity (0.900 and 1.200 µ mol pi $g^{-1}h^{-1}$) was recorded at 20 and 25 DAS, respectively in organic treatment *i.e.* application of 50 % FYM + 50 % VC + panchagavya @ 3 %. From this study, it is concluded that for organic seedling production application of 50 % FYM + 50 % VC + foliar spray of panchagavya @ 3 % on 12th and 18th DAS found better in paddy.

Citation: Gajendra Khidrapure, Vasudevan, S. N., Doddagoudar, S. R., Sreenivas, A. G. and Satyanarayana Rao, 2016. "Organic seedling production in paddy", *International Journal of Current Research*, 8, (09), 39290-39294.

INTRODUCTION

Rice (*Oryza sativa* L.) is the major staple food for more than half of the global population and supplies 50 to 80 per cent calories of energy and hence it is considered as the "global grain". Intensive cultivation of paddy has caused considerable damage to the environment and natural resources including build up of salinity or alkalinity, water logging, water pollution, depletion of groundwater and health hazards due to excessive use of agro chemicals and pesticides and release of higher methane gas to the environment. This has forced the farmers, scientists and policy makers to look at the organic approach of nutrient management in paddy. Organic agriculture is one among the broad spectrum of production methods that are supportive of the environment vis-*a*-*vis* minimizing the farm expenditure. The demand for organic food is steadily increasing both in developed as well as developing countries with an annual growth rate of 20–25 per cent (Rameshwar and Singh 2005). Organic cultivation helps in improvement of crop or seed quality and reduces environment pollution. It brightens the prospects of export of organic food items. Now there are signs of change across the agriculture landscape of the country towards organic farming. Paddy produced by organic farming had higher grain quality. International Federation of Organic Agriculture Movement (IFOAM) has clearly laid down the condition that in order to get organic certification for the agricultural produce, the seed used for sowing should also have been produced organically. Organic seed production involving different sources of organic manures, bio-fertilizers, green manures, bio-pesticides and botanicals. When one makes an attempt on organic seed production in paddy, it becomes essential to raise an organic nursery (Alex and Krishnaswamy 2007). The information on organic seedling production in paddy is meager and scanty. Therefore, the present investigation was carried out to know the effect of different sources of organics on seedling growth and development.

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MATERIALS AND METHODS

The experiment was carried out in the farmers' organic field at Neer Manvi, Manvi Taluk, Raichur District, Karnataka, India during *kharif* 2013 and *kharif* 2014. The experiment was laid down in RBD design with three replications and 13 treatments

viz., T_1: control (RDF) + inorganic plant protection, T_2: 100 % RDN through FYM, T_3: 100 % RDN through vermicompost (VC), T_4: 50 % RDN through FYM + 50 % RDN through VC, T_5: T_2 + vermiwash @ 10 %, T_6: T_3 + vermiwash @ 10 %, T_7: T_4 + vermiwash @ 10 %,T_8: T_2 + cow urine @ 10 %, T_9: T_3 + cow urine @ 10 %, T_{10}: T_4 + cow urine @ 10 %, $T_{11:}$ T_2 + panchagavya @ 3 %, $T_{12:}$ T_3 + panchagavya @ 3 % and $T_{13:}$ T_4 + panchagavya @ 3 %. Nursery bed of 1 x 1 m dimension was prepared. Equal amount of nitrogen in the form of FYM and vermicompost were applied and foliar spray of vermiwash, cow urine and panchagavya on 12 and 18 DAS as per treatments and organic plant protection was common for all the treatments except control. Then, the seeds at the rate of 50 g m^{-2} were sown in all the plots irrespective of treatments. Observations on shoot and root length of ten randomly selected seedlings were recorded in each plot and mean was expressed in cm. The seedling dry matter production was recorded by adopting oven dry method and expressed in g per seedlings^{-10}. The chlorophyll content (SPAD reading) of leaves was measured by using SPAD meter. The root volume was determined by water displacement method (John Harrington *et al*. 1994) and mean value was expressed in cc seedling^{-1}. Root ATPase activity was measured (Unbreit *et al.* 1964) by taking one gram of fresh root sample at random from each plot was homogenized with 0.125 M sucrose solution and cold centrifuged at 4°C for 15 min. The supernatant from each sample was collected and the volume made up to 10 ml with distilled water in a test tube. A test tube with 10 ml of distilled water served as the blank. Then 0.2 ml of solution from sample and blank tubes were taken and to this 9 ml of 0.25 M sucrose solution was added. Then 0.3 ml of 0.02 M magnesium chloride and calcium chloride solutions were poured one after other into both the sample and blank tubes. The aggregate solution was kept for incubation at 37°C in a water bath. Eventually the reaction was terminated by adding 1 ml of TCA and the enzyme activity was expressed in units of micromole of inorganic phosphorous produced gram^{-1} of fresh tissue per hour.

Thrips count in the seedlings was taken in early morning by passing wet palm at five random places in each plot. Number of live thrips adhered to the palm were counted and mean was expressed in number. The mean data of the experiment were statistically analyzed by adopting appropriate statistical methods as outlined by (Panse and Sukhatme 1978). The critical differences were calculated at five per cent level of probability wherever 'F' test was found significant for various growth parameters under study.

RESULTS AND DISCUSSION

Proper nutrient management in nursery will reflect on the behavior of crop in the main field. Proper fertilization of nursery beds produce early and deep rooted seedlings which will therefore, have a great resistance to set backs in the main field (Ramamoorthy *et al*. 2000). Among the treatments, inorganic treatment (T_9) recorded significantly highest mean shoot length (15.35 and 20.29 cm), chlorophyll content (25.09 and 33.20 SPAD value), dry matter production (0.489 and 0.617 g seedlings^{-10}) and number of thrips (5.20 and 4.25 hill^{-1}) at 20 and 25 DAS, respectively. This could be ascribed to the effect of inorganic nutrients in increasing seedling growth due to immediate nutrient availability at initial growth stages of seedling in nursery (Sucharita and Boopathi 2000). The increase in chlorophyll content with N application might be due to increase in synthesis of pigments (Bose and Srivastava 1979), soluble protein (Raja 2003). The increased chlorophyll content was responsible for production of lengthier shoot and accumulation of maximum dry matter. These results were in line with the findings of (Mahadevappa *et al*., 1975, Kale *et al.,* 1992, Singh *et al.,* 1999) in paddy and (Arancon *et al.,* 2003) in tomato. Generally, organic manures improve nutrient status of soil pool in view of slow release of nutrients. Organics such as FYM and vermicompost alone or in combination with vermiwash, cow urine and panchagavya sprays were used as organic source of nutrient for nursery raising. Among the treatments, FYM + vermicompost with panchagavya @ 3 % as foliar spray at 12 and 18 DAS (T_{13})

Table 1. Influence of organic nutrients on shoot and root length of paddy (cv. Sona masoori) seedlings in nursery

Treatments (T)	Shoot length (cm)						Root length (cm)					
	20th Day			25th Day			20th Day			25th Day		
	2013	2014	Pooled Mean	2013	2014	Pooled Mean	2013	2014	Pooled Mean	2013	2014	Pooled Mean
T_1	15.20	15.50	15.35	20.26	20.33	20.29	9.66	9.70	9.68	16.68	16.77	16.72
T_2	12.50	12.90	11.70	16.39	16.44	16.42	7.80	7.87	7.84	13.81	13.96	13.89
T_3	13.20	13.24	13.22	18.18	18.23	18.21	9.18	9.19	9.18	15.59	15.67	15.63
T_4	13.00	13.19	13.10	17.50	17.81	17.66	8.69	8.74	8.72	15.22	15.38	15.30
T_5	13.66	13.80	13.73	18.73	18.88	18.81	9.40	9.50	9.45	15.73	15.86	15.80
T_6	13.88	13.90	13.89	19.13	19.17	19.15	9.60	9.66	9.63	16.32	16.38	16.35
T_7	14.00	14.30	14.15	19.28	19.36	19.32	9.75	10.00	9.88	16.86	16.91	16.88
T_8	13.44	13.50	13.47	18.51	18.65	18.58	9.33	9.36	9.34	14.83	14.95	14.89
T_9	13.71	13.83	13.77	19.08	19.11	19.10	9.51	9.55	9.53	16.07	16.13	16.10
T_{10}	13.90	13.93	13.92	19.19	19.21	19.20	9.70	9.85	9.78	16.79	16.86	16.83
T_{11}	14.31	14.35	14.33	18.73	18.85	18.79	9.43	9.45	9.44	15.88	15.93	15.91
T_{12}	14.50	14.66	14.58	20.07	20.15	20.11	9.78	10.13	9.96	16.91	16.98	16.94
T_{13}	15.00	15.20	15.10	20.19	20.25	20.22	9.90	10.30	10.10	16.98	17.07	17.03
Mean	13.83	13.96	13.87	18.87	18.96	18.91	9.36	9.48	9.42	15.98	16.07	16.02
SEm±	0.27	0.30	0.29	0.42	0.47	0.44	0.56	0.61	0.58	0.55	0.58	0.56
CD @ 5 %	0.80	0.88	0.84	1.23	1.38	1.30	NS	NS	NS	1.61	1.70	1.65

T_1: Control (RDF)
T_2: 100 % FYM
T_3: 100 % VC
T_4: 50 % FYM + 50 % VC
T_5: T_2 + Vermiwash @ 10 %
T_6: T_3 + Vermiwash @ 10 %
T_7: T_4 + Vermiwash @ 10 %
T_8: T_2 + Cow urine @ 10 %
T_9: T_3 + Cow urine @ 10 %
T_{10}: T_4 + Cow urine @ 10 %
T_{11}: T_2 + Panchagavya @ 3 %
T_{12}: T_3 + Panchagavya @ 3 %
T_{13}: T_4 + Panchagavya @ 3 %
NS- Non significant
VC- Vermicompost

Table 2. Influence of organic nutrients on root volume and root ATPase activity of paddy (cv. Sona masoori) seedlings in nursery

Treatments (T)	Root volume (cc seedling^{-1})						Root ATPase activity (µ mol pi g^{-1}h^{-1})					
	20th Day			25th Day			20th Day			25th Day		
	2013	2014	Pooled Mean	2013	2014	Pooled Mean	2013	2014	Pooled Mean	2013	2014	Pooled Mean
T_1	0.951	0.956	0.954	0.978	0.981	0.980	0.730	0.800	0.765	0.957	0.977	0.967
T_2	0.716	0.727	0.722	0.818	0.827	0.823	0.477	0.517	0.497	0.770	0.833	0.802
T_3	0.850	0.853	0.852	0.892	0.897	0.895	0.540	0.550	0.545	0.850	0.870	0.860
T_4	0.891	0.824	0.858	0.873	0.888	0.881	0.520	0.520	0.520	0.833	0.843	0.838
T_5	0.883	0.887	0.885	0.911	0.919	0.915	0.570	0.593	0.582	0.867	0.867	0.867
T_6	0.939	0.944	0.942	0.953	0.969	0.961	0.700	0.770	0.735	0.947	0.977	0.962
T_7	0.973	0.978	0.976	1.111	1.113	1.112	0.840	0.850	0.845	1.053	1.063	1.058
T_8	0.750	0.763	0.757	0.840	0.843	0.842	0.500	0.510	0.505	0.797	0.847	0.822
T_9	0.913	0.921	0.917	0.941	0.953	0.947	0.607	0.647	0.627	0.927	0.947	0.937
T_{10}	0.966	0.969	0.968	0.997	1.015	1.006	0.820	0.840	0.830	1.003	1.033	1.018
T_{11}	0.897	0.907	0.902	0.924	0.933	0.929	0.580	0.600	0.590	0.900	0.900	0.900
T_{12}	0.981	0.996	0.989	1.115	1.120	1.118	0.850	0.860	0.855	1.100	1.100	1.100
T_{13}	0.993	1.021	1.007	1.121	1.125	1.123	0.870	0.930	0.900	1.117	1.283	1.200
Mean	0.900	0.904	0.902	0.960	0.968	0.964	0.662	0.691	0.677	0.932	0.965	0.949
SEm±	0.019	0.026	0.022	0.027	0.036	0.031	0.055	0.065	0.060	0.060	0.069	0.065
CD @ 5 %	0.051	0.075	0.063	0.078	0.095	0.086	0.162	0.191	0.177	0.175	0.201	0.188

T_1: Control (RDF)
T_2: 100 % FYM
T_3: 100 % VC
T_4: 50 % FYM + 50 % VC
T_5: T_2 + Vermiwash @ 10 %
T_6: T_3 + Vermiwash @ 10 %
T_7: T_4 + Vermiwash @ 10 %
T_8: T_2 + Cow urine @ 10 %
T_9: T_3 + Cow urine @ 10 %
T_{10}: T_4 + Cow urine @ 10 %
T_{11}: T_2 + Panchagavya @ 3 %
T_{12}: T_3 + Panchagavya @ 3 %
T_{13}: T_4 + Panchagavya @ 3 %
VC- Vermicompost

Table 3. Influence of organic nutrients on chlorophyll content and dry matter production in paddy (cv. Sona masoori) seedlings in nursery

Treatments (T)	Chlorophyll content (SPAD value)						Dry matter production (g seedlings^{-10})					
	20th Day			25th Day			20th Day			25th Day		
	2013	2014	Pooled Mean	2013	2014	Pooled Mean	2013	2014	Pooled Mean	2013	2014	Pooled Mean
T_1	25.07	25.11	25.09	33.10	33.30	33.20	0.486	0.491	0.489	0.613	0.621	0.617
T_2	17.69	18.02	17.86	23.19	23.22	23.21	0.370	0.377	0.374	0.507	0.515	0.511
T_3	20.31	20.54	20.43	26.19	26.38	26.29	0.385	0.393	0.389	0.525	0.533	0.529
T_4	19.93	20.03	19.98	25.30	25.40	25.35	0.379	0.386	0.383	0.520	0.531	0.526
T_5	21.91	22.07	21.99	28.73	28.81	28.77	0.407	0.411	0.409	0.544	0.553	0.549
T_6	23.19	23.26	23.23	30.71	30.80	30.76	0.421	0.433	0.427	0.572	0.580	0.576
T_7	24.39	24.45	24.42	32.30	32.51	32.41	0.449	0.452	0.451	0.585	0.592	0.589
T_8	20.88	20.97	20.93	27.33	27.41	27.37	0.401	0.404	0.403	0.529	0.536	0.533
T_9	22.61	22.87	22.74	29.38	29.92	29.65	0.413	0.420	0.417	0.561	0.566	0.564
T_{10}	23.91	24.04	23.97	31.03	31.11	31.07	0.441	0.445	0.443	0.577	0.583	0.580
T_{11}	24.51	24.69	24.60	32.78	32.86	32.82	0.453	0.460	0.457	0.592	0.596	0.594
T_{12}	24.69	24.73	24.71	32.91	32.96	32.94	0.462	0.469	0.466	0.601	0.607	0.604
T_{13}	24.81	24.93	24.87	33.01	33.05	33.03	0.480	0.483	0.482	0.608	0.610	0.609
Mean	22.61	22.75	22.68	29.69	29.82	29.76	0.427	0.433	0.430	0.564	0.571	0.568
SEm±	0.35	0.37	0.36	0.38	0.40	0.39	0.007	0.008	0.008	0.008	0.009	0.009
CD @ 5 %	1.04	1.10	1.07	1.15	1.21	1.18	0.021	0.023	0.022	0.024	0.027	0.026

T_1: Control (RDF)
T_2: 100 % FYM
T_3: 100 % VC
T_4: 50 % FYM + 50 % VC
T_5: T_2 + Vermiwash @ 10 %
T_6: T_3 + Vermiwash @ 10 %
T_7: T_4 + Vermiwash @ 10 %
T_8: T_2 + Cow urine @ 10 %
T_9: T_3 + Cow urine @ 10 %
T_{10}: T_4 + Cow urine @ 10 %
T_{11}: T_2 + Panchagavya @ 3 %
T_{12}: T_3 + Panchagavya @ 3 %
T_{13}: T_4 + Panchagavya @ 3 %
VC- Vermicompost

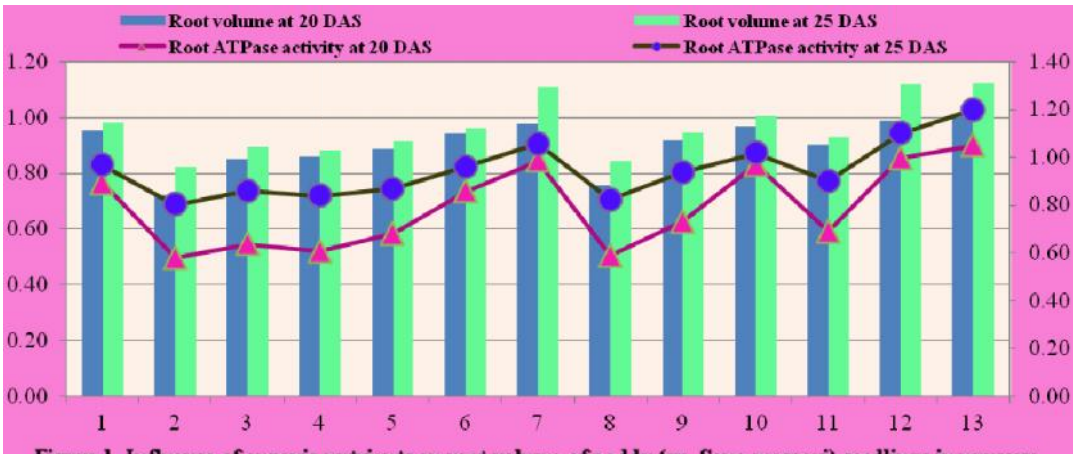

Figure 1. Influence of organic nutrients on root volume of paddy (cv. Sona masoori) seedlings in nursery

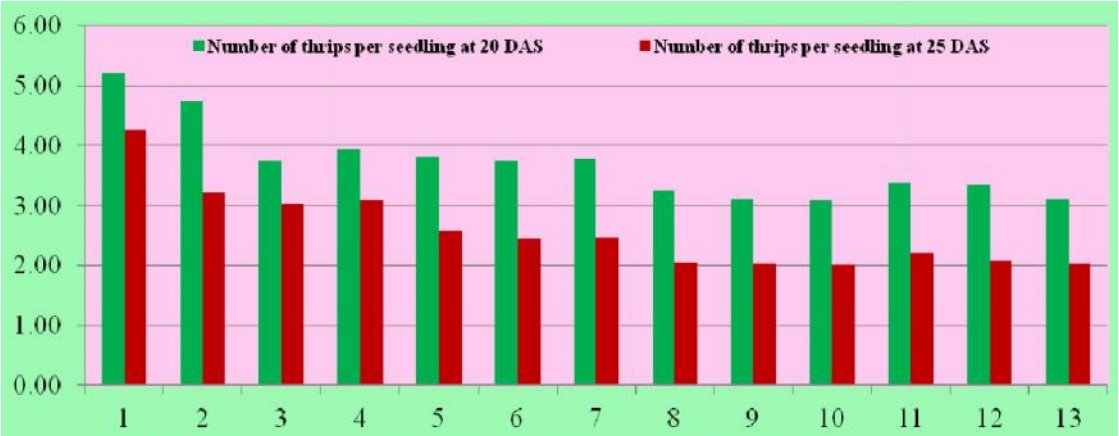

Figure 2. Influence of organic nutrients on thrips count in paddy (cv. Sona masoori) seedlings in nursery

recorded significantly higher mean root length (10.10 and 17.03 cm), root volume (1.007 and 1.123 cc seedling $^{-1}$) and root ATPase activity (0.900 and 1.200 µ mol pi $g^{-1}h^{-1}$) at 20 and 25 DAS, respectively (Table 1, 2 and 3). Earlier findings revealed that healthy and vigourous seedling with desirable root characters could be obtained by nursery manuring (Rajendran 1991). The positive effect of T_{13} (FYM + vermicompost with panchagavya) treatment might be due to enhanced activity of beneficial microbes like N_2 fixers and colonization by mycorrhizal fungi and their increased role in N_2 fixation and phosphate mobilization leading to better uptake by the plants which might have resulted in better growth of seedlings was observed in plots supplied with FYM + vermicompost + panchagavya foliar spray. The increased root length and root volume were mainly due to the increased total ATPase activity which helps in increased activity of cell division and cell elongation resulting in increased root growth (Maeshima 1990 in mungbean; Albert, 2004 in tomato and Das *et al*. 2013 in rice). The probable reason for increased total root ATPase enzyme activity (Fig 1) in T_{13} could be due to combined application of organic manure along with spraying of panchagavya. Organic manure possesses a variety of constituents like macronutrients, micronutrients, enzymes, hormones and vitamins (Jose 2002; Raumjit Nokkoul 2014) and panchagavya known to contain plant growth promoting rhizobacteria (Kanimozhi 2003 and Albert 2004). The damage due to thrips was reduced due to spraying of cow urine and panchagavya (Fig 2). This might be due to pesticidal property of cow urine (Mohanty *et al*. 2014). Similarly, (Mishra 2002) reported that soil drenched with maha-panchagavya slurry 10 per cent successfully controlled tomato wilt better than carbendazim and panchagavya spray recorded the least population of cutworms in thyme crop (Selvaraj *et al.* 2003). Panchagavya has the properties of both fertilizer as well as biopesticide (Kanimozhi 2003 and Anon 2014). From this study, it is concluded that for organic seedling production application of 50 % FYM + 50 % VC + foliar spray of panchagavya @ 3 % on 12th and 18th DAS found better in paddy.

Acknowledgement

The authors acknowledge the Department of Science & Technology (DST), Government of India for providing INSPIRE fellowship, UAS, Raichur for providing laboratory facilities to carry out research work.

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